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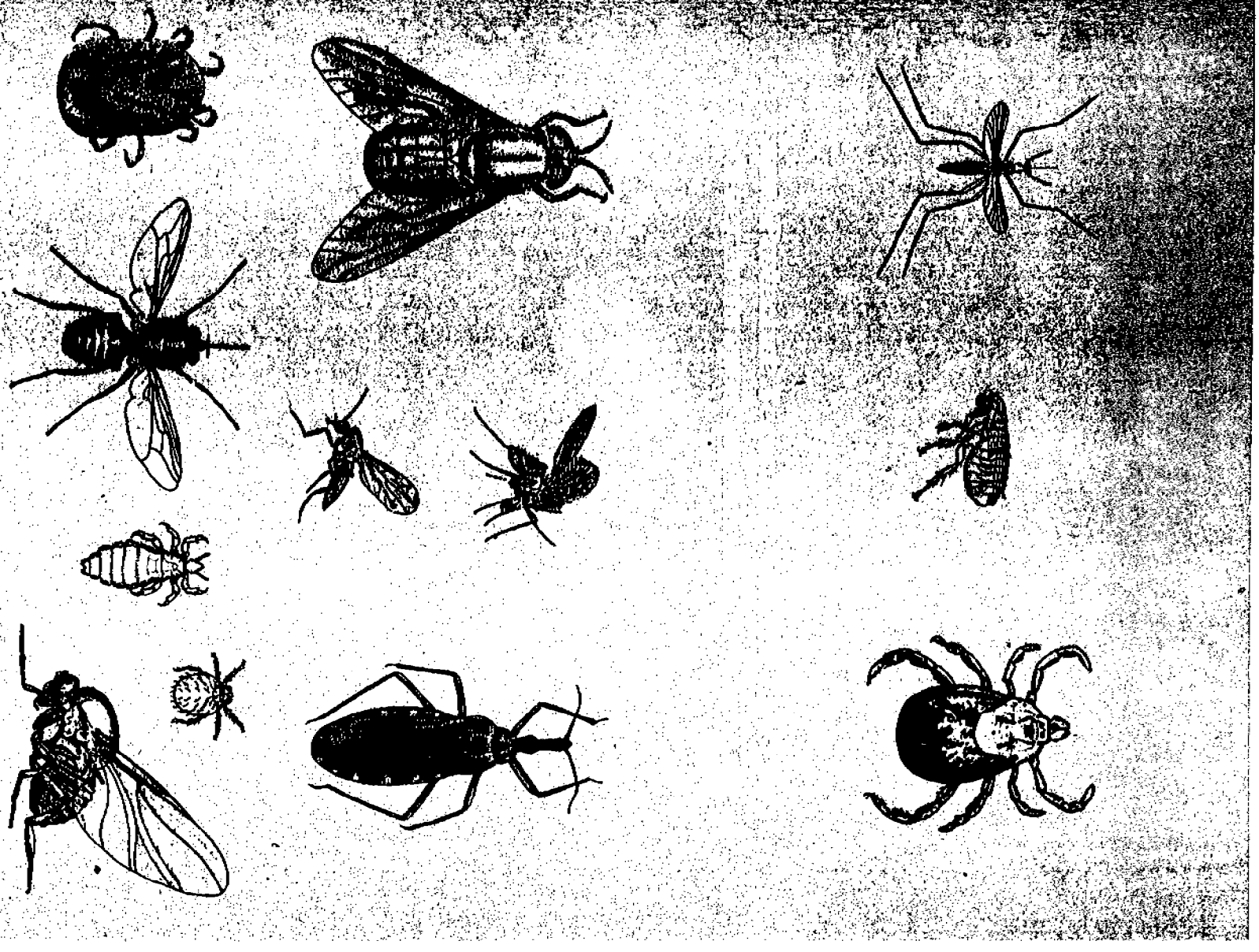

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Historically, in most military conflicts, combat power has been reduced more significantly by disease and nonbattle injuries (DNBI) than from direct combat casualties. A large number of diseases affecting the troop strength of deployed units is directly attributed to disease-carrying arthropods. Moreover, arthropods can inflict severe physical, psychological, and economic stresses which threaten the military mission. Not only do they transmit disease, but the bites they inflict can be painfully distracting and can lead to devastating secondary infections, dermatitis, or allergic reactions.

This guide illustrates personal protective measures that can be used to help protect the individual against arthropod attack. These measures include the use of protective clothing and equipment, repellants, pesticides, and other strategies.

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U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
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REPLY TO
ATTENTION OF

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June 1991

USAEHA TECHNICAL GUIDE NO. 174

PERSONAL PROTECTIVE TECHNIQUES AGAINST INSECTS AND OTHER ARTHROPODS OF MILITARY SIGNIFICANCE

CHAPTER 1
INTRODUCTION

1-1. Purpose

This technical guide (TG) provides preventive medicine (PVNTMED) information and guidance to Department of Defense (DOD) personnel who may come into contact with nuisance or disease-bearing arthropods (disease vectors), or who are responsible for protecting the health of such personnel. This guide illustrates personal protective measures that can be used to help protect the individual against arthropod attack. These measures include the use of protective clothing and equipment (PCE), repellents, pesticides, and other strategies.

1-2. References

References are listed in Appendix A.

1-3. Explanation of Abbreviations

Abbreviations used in this TG are explained in the glossary.

1-4. Background

a. Historically, in most military conflicts, combat power has been reduced more significantly by disease and nonbattle injuries (DNBI) than from direct combat casualties. A large number of diseases affecting the troop strength of deployed units is directly attributed to disease-carrying arthropods. Moreover, arthropods can inflict severe physical, psychological, and economic stresses which threaten the military mission. Not *only* do they transmit disease, but the bites they inflict can be painfully distracting and can lead to devastating secondary infections, dermatitis, or allergic reactions.

> Use of trademarked names does not imply endorsement by the U.S. Army but is intended only to assist in identification of a specific product.

b. Wartime or peacetime tactical operations often create conditions that are conducive to disease transmission. The very nature of these missions may place individuals into contact with previously unencountered disease vectors. In addition, these situations encourage pest proliferation due to disturbances to the environment, such as decreased sanitation, increased pest breeding sites, and crowded living conditions.

c. Table 1-1 lists the major arthropod pests of military importance and the major diseases that they transmit.

(1) In most geographical regions of the world, mosquitoes continue to rank as the foremost disease vectors and nuisance pests affecting man. They transmit three of the most serious vector-borne diseases which jeopardize U.S. forces: malaria, dengue, and viral encephalitis.

(2) Sand flies transmit other major diseases of military importance such as sand fly fever and leishmaniasis.

(3) Additional arthropods that may cause disease or nuisance problems are black flies, deer flies, horse flies, stable flies, tsetses, greenheads, biting midges, fleas, mites, ticks, lice, kissing bugs, bees, wasps, ants, and scorpions.

(4) Ticks particularly can host a broad range of pathogens, including the most recently noted agents of Lyme disease and possibly human ehrlichiosis.

(5) Although some arthropods, notably filth flies, do not bite and are therefore not true vectors of disease, they can mechanically transmit many serious illnesses such as dysentery, cholera, salmonella, shigellosis, and typhoid fever.' In addition to transmitting disease, filth flies are numerous enough in many areas to pose an extreme nuisance, constantly seeking moisture from sweat and from the eyes, nose, and mouth.

d. Personal protection is an individual responsibility, although it is also an important adjunct to unit-level and PVNTMED team pest management countermeasures. Soldiers and supporting medical personnel must be aware of the following:

(1) Types of arthropods that are present in an area

(2) Their habits

(3) The threat that they represent

(4) The resources that are available for protection

(5) How to use these resources effectively.

COMMAND EMPHASIS IS ESSENTIAL! Commanders and medical personnel must monitor compliance with personal protective strategies to ensure that all appropriate protective resources are being provided, and that soldiers are using these protective resources properly.[3]

TABLE l-l. ARTHROPODS OF MILITARY IMPORTANCE AND THE MAJOR DISEASES THEY TRANSMIT[4,54]

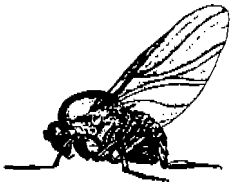
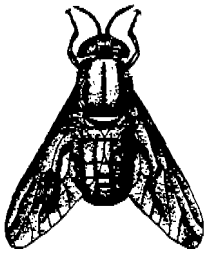
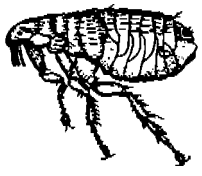
Visual ID	Common Name	Genus	Diseases
	Biting midges	Culicoides	. Visceral filariasis (mansonellosis) . Oropouche fever
	Black flies	Simulium	• Onchocerciasis
	Deer flies	Chrysops	. Eye worm disease (loa loa) . Tularemia
	Fleas	Xenopsylla	. Plague . Murine typhus
	Kissing bugs	Rhodnius, Triatoma, Panstrongylus	. Chagas' disease (American trypanosomiasis)

TABLE l-l. ARTHROPODS OF MILITARY IMPORTANCE AND THE MAJOR DISEASES THEY TRANSMIT'? (Continued)

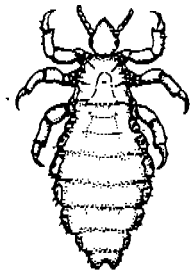
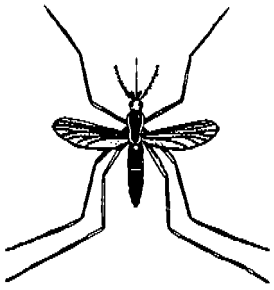
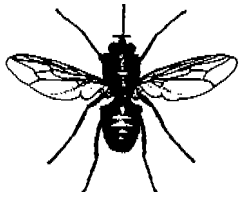
Visual ID	Common Name	Genus	Diseases
	Lice	Pediculus	. Epidemic typhus . Relapsing fever . Trench fever
	MITES		
	Chigger mites	Leptothrombidium	. Scrub typhus
		Sarcoptes	. Scabies
	Mouse mites	Lyponyssoides	• Rickettsialpox
	Mosquitoes	Aedes	• Dengue • Yellow fever . Viral encephalitis
		Anopheles	. Malaria
		Culex, Aedes	. Viral fever5 (Oropouche, Rift Valley, Chickungunya)
		All three	. Lymphatic filariasis (Wuchereriasis, Brugiasis)
	Sand flies	Phlebotomus	. Leishmaniasis . Sand fly fever • Bartonellosis

TABLE 11-11. ARTHROPODS OF MILITARY IMPORTANCE AND THE MAJOR DISEASES THEY TRANSMIT[4,54] (Continued)

Visual ID	Common Name	Genus	Diseases
	TICKS		
	Hard ticks	Dermacentor	. Spotted fevers . Colorado tick fever
		Ixodes	. Lyme disease . Babesiosis . Viral encephalitis . Tularemia
		Hyalomma	. Crimean-Congo hemorrhagic fever
	Soft ticks	Ornithodorus	. Relapsing fever
	Tsetses	Glossina	. Trypanosomiasis (African sleeping sickness)

CHAPTER 2
METHODS OF PROTECTION

Section I.
Introduction

2-1. General

Arthropod-borne diseases and nuisance pests can be prevented or controlled by using a number of techniques including personal protective measures and environmental controls. In many situations, personal protective measures such as avoiding infested areas, or the use of physical barriers or chemical repellents, may be the only means of protection available. Environmental controls, while not a primary focus of this TG, are nevertheless mentioned to illustrate the total integrated approach that should be employed by a unit in field situations. They include such techniques as pesticide application, sanitation, and mechanical modifications.

Section II.
Avoidance

2-2. Information Sources and Field Strategies

The most effective and obvious means of preventing exposure to arthropods is to avoid their known habitats.

a. PVNTMED personnel should provide guidance on the presence of arthropod populations in an area based on information obtained through surveillance or via intelligence sources.

(1) The Defense Pest Management Information Analysis Center (DPMIAC) of the Armed Forces Pest Management Board (AFPMB) compiles disease vector ecology profiles (DVEPs) which are concise, comprehensive summaries of the vector-borne diseases which occur in specific countries. The DVEPs focus on causative agents, vector importance, bionomics, behavior, and pesticide resistance, as well as provide basic information on the geography and customs of each country. They may be obtained from the DPMIAC, Forest Glen Section, Walter Reed Army Medical Center, Washington, DC 20307-5001, DSN 2914365, commercial 301-427-5365.

(2) The Navy prepares vector risk assessment profiles (VECTRAPs) which are concise, up-to-date summaries of practical information on vector ecology and disease incidence in specific countries. They are available as hard copy or on computer disk from the Navy Environmental Health Center, 2510 Walmer Avenue, Norfolk, VA 23513-2617, OSN 564-7575, extension 457, commercial 804-444-7575, extension 457.

(3) In addition, up-to-date worldwide information on diseases and vectors may be obtained from the Armed Forces Medical Intelligence Center (AFMIC), Fort Detrick, MO 21701-5004, DSN 343-7269, commercial 301-663-7269.

b. Absolute avoidance of arthropod pests is often neither practicable nor possible. If the tactical situation allows, choose bivouac sites which are dry, open, and as uncluttered as possible. Avoid sites with rodent burrows and proximity to local settlements, animal pens, and other areas where arthropod infestations are likely to be concentrated. Limit or avoid contact with indigenous human populations in third world countries because they are reservoirs for many diseases of military importance.

Section III. Physical Barriers

2-3. Clothing

a. Clothing is the first direct line of personal defense against arthropods. Proper wearing of the field uniform is essential to minimize the amount of exposed skin (Figure 2-1). If the risk of heat stress is a factor in a particular environment, common sense or advice from medical personnel should dictate when the following recommendations are not practical.

Figure 2-1. Proper Wearing of Field Uniform Minimizes Exposure to Arthropod Attack

(1) Tucking the pant leg into the boot or into the sock forces nonflying pests such as ticks to climb up the outside of the pant leg, thus decreasing access to the skin and increasing the likelihood of being seen.

(2) Rolling the sleeves down and closing the collar helps protect the arms and neck from attack. This is especially important from dusk until dawn when many mosquito species and other nocturnal blood feeders become active.

(3) It is difficult for attacking pests to bite through the uniform fabric unless it is pulled tightly against the skin. Therefore, the uniform should be worn loosely, with an undershirt worn underneath the shirt to act as an added barrier.[40] The undershirt should be tucked into the pants.

(4) The field cap and its brim help protect the head and face. Some biting insects tend to avoid the shaded area of the face under the cap's brim.[38] In areas heavily infested with flying pests, a head net can be used over the cap or helmet.

b. When in tick-infested habitats, check clothing frequently, and use the buddy system to check areas of the body that cannot easily be seen during self-examination (Figure 2-2).

Figure 2-2. Buddy-System Check for Ticks

(1) Ticks can be picked off of clothing by hand, However, avoid crushing them with your fingernails because their body fluids may be infective. After removal, disposal may pose a problem. If returned to the immediate area, ticks may reattach to the clothing or attack another individual. They can be destroyed by placing them in alcohol, solvent, or a petroleum product such as gasoline, if available.

(2) Ordinary masking tape, cellophane tape, or similar substitute, is useful to remove ticks from clothing. A ring of tape can be made around the hand by leaving the sticky side out, attaching the two ends, and then dabbing against the clothing. Ticks will adhere to the tape, The tape can then be folded carefully over the ticks to prevent their escape and discarded with the trash.

(3) A lint roller (available from post/base exchanges) is a very efficient means of quickly removing large numbers of ticks from the uniform, especially the very tiny larvae which may be present in clusters of several hundred.

c. Once the clothing is removed, it is important to carefully check all areas of the body for evidence of ticks or chigger mite bites. Reexamine the clothing, inside and out, and remove and destroy all ticks.

d. If a tick is found attached to the body, seek medical authorities for proper removal, or follow these guidelines:

(1) Using forceps (tweezers), grasp the ticks' mouthparts against the skin and pull back slowly and steadily. The long, central mouthpart called the hypostome is barbed and, therefore, difficult to remove. Some tick species also secrete a cementing substance as it feeds which secures its mouthparts firmly in the flesh. It is important to be patient, and to continue to pull steadily until the tick can be eased out. Do not squeeze or crush the tick's body because this may force infective body fluids into the wound.

(2) If forceps are not available, protect the fingers with a piece of tissue, or other suitable material, and remove the tick carefully by hand. To avoid secondary infection, wash the wound site with soap and water, then apply an antiseptic.

e. Since chigger mites are very small and difficult to see, their presence is generally not detected until the appearance of intensely itching bites. Wearing repellent-impregnated uniforms greatly reduces the likelihood of being infested with chiggers (see Section IV, Repellents).' Bathing after field work, or as soon as operationally permissible, may reduce the severity of the resultant chigger infestation. Medical personnel may prescribe an antipruritic or antibiotic to help 'reduce itching or secondary infection.

f. To reduce the chance of being bitten by spiders, scorpions, and snakes:

(1) Always wear shoes or boots coupled with the added protection of socks during waking hours.

(2) Never walk in bare or stocking feet.

(3) Shake out boots before putting them on.

(4) Do not reach into concealed areas that might harbor spiders or scorpions without carefully checking first.

2-4. Protective Equipment

a. Introduction. There are several items available through the military supply system which can be used to augment the physical protection afforded by clothing alone (see Table 2-1).[2, plus updates]

(1) In areas heavily infested with flying pests, a head net can be used over the cap or helmet. Indoor protection can be greatly enhanced by using bed nets and tent screens. Unlike head nets, however, the mesh size of bed netting and tent screens is not fine enough to keep out all biting arthropods, especially biting midges and sand flies. Treating bed nets and tent screens with repellents can significantly reduce the ability of these arthropods to gain entry (see insect bar-paragraph 2-4, and repellents Section IV).[11,50]

(2) In addition, where midges are a serious problem, head nets may also be worn while sleeping.

(3) At night, protection may be further improved by keeping light to a minimum to avoid attracting nocturnal feeders.

TABLE 2-1. PCE AND REPELLENTS AVAILABLE THROUGH THE MILITARY SUPPLY SYSTEM[2, plus updates]

NSN	Nomenclature	Unit of Issue
6840-01-067-6674	Insecticide, d-Phenuthrin. 2% aerosol	12-oz can
6840-00-753-4963	Insect repellent, clothing application, 76% deet, 25% ethanol	2-oz bottle
6840-01-284-3982	Insect repellent, personal application (3M®/EPA 58007-1), 33% deet	12 242 tubes/box
6840-00-142-8965	Insect repellent stick, personal application, 33% deet	12 1-oz cartridges/ box
6840-01-278-1336	Insect repellent, clothing application. aerosol, 0.6% permethrin	12 6-oz cans/box
6840-01-334-2666	Insect repellent, clothing application, 46% permethrin	12 151-ml bottles/box
6840-01-345-0237	Insect repellent, clothing application, IDAA kit, 40% permethrin	12 kits/box
8415-00-935-3130	Head net, insect	EA
8415-01-035-0846 -0847 -0848	Parka, fabric mesh, insect repellent (deet jacket), small, medium, and large	EA
7210-00-266-9736	Insect bar (netting), cat type	EA
7210-00-267-5641	Poles, insect bar (for suspending insect bar)	4 poles/set
3740-00-641-4719	Sprayer, insecticide, manually carried, pressure type, 2-gallon, equipped with pressure gauge	EA
3740-01-332-8746	Gauge, pressure, pesticide sprayer (for retrofit use on 2-gallon sprayers un-equipped with a gauge)	EA
4330-01-332-1639	Filter, gauge, pesticide sprayer (must be used with gauge NSN 3740-01-332-8746)	EA

® 3M is a registered trademark of Minnesota Mining and Manufacturing Co., St. Paul, Minnesota.

b. Insect Bar (Mosquito Bed Net).

(1) The insect bar (Figure 2-3) (national stock number (NSN) 7210-00-266-9736) is a finely woven (27 mesh/inch), olive drab, nylon canopy which can be used with the folding cot, hammock, steel bed, or shelter half-tent. An insect'bar frame (NSN 7210-00-267-5641, poles, insect bar) is available for use with the folding cot.

(2) The insect bar should be erected and supported in such a way as to prevent contact of the net with the sleeping person. This will prohibit mosquitoes and other biting flies from biting through the net.

(3) Install the poles on the inside of the net for the cot or on the outside of the net for the steel bed.

(4) Tuck the net in around the mattress, under the cot, or under the sleeping bag to preclude entry of arthropods. Bed nets should be installed before dusk, when mosquitoes become active.

(5) Prior to retiring, any mosquitoes trapped inside the enclosure should be killed with the standard insecticide aerosol, 2-percent d-phenothrin (NSN 6840-01-067-6674) (Figure 2-4). Avoid breathing the pesticide vapors while spraying, and DO NOT USE 2-PERCENT D-PHENOTHRIN ON THE SKIN OR CLOTHING.

(6) For added protection, spray the net lightly with permethrin (see paragraph 2-7) before getting inside. This will protect against arthropods which are small enough to fit through the mesh of the net. Allow it to dry before handling. The permethrin treatment should be effective for several months if not rinsed or washed out.

c. Insect Head Net.

(1) The insect head net (Figure 2-5) (NSN 8415-00-935-3130) is a finely woven (30-mesh/inch), olive drab, nylon head covering which can be worn over the bare head, cap, helmet, or helmet liner (Figure 2-6). The cloth top piece has an elastic headband on the inside that fits securely over the head gear. A fabric-covered metal hoop holds the net away from the head and neck.

(2) Put on the head net so that the elastic headband rests comfortably on the upper part of the forehead or grips close above the brim of the helmet. Tie the drawstring permanently so that the drawstring knot is about 8 inches below the chin and the net fits snugly below the collar, both front and back. Hook the elastic loops found at the drawstring edge of the net over the breastpocket buttons.

(3) For quick removal of the head net, grasp the back edge where it rests over the collar and pull forward over the head (figure 2-7).

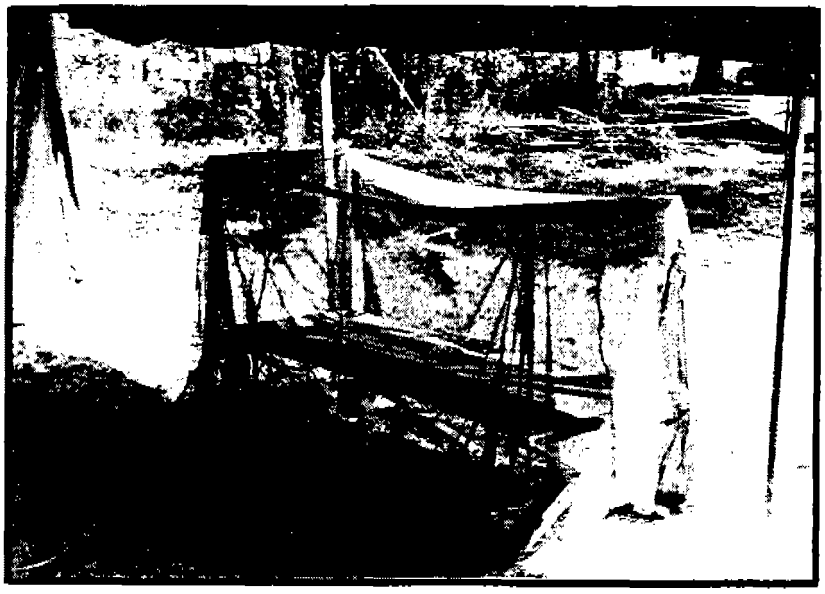


Figure 2-3. Insect Bar (Mosquito Bed Net), Used With Insect Bar Frame, on Folding Cot

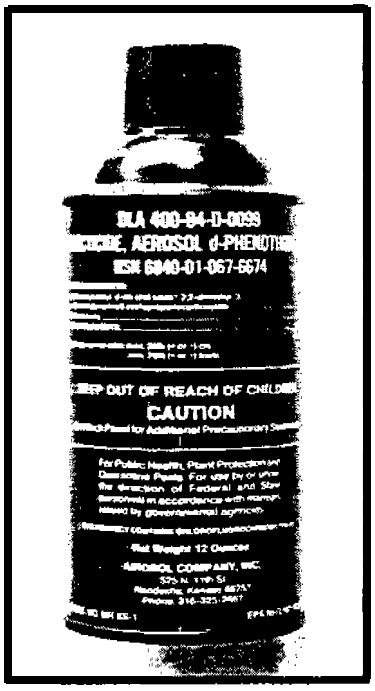


Figure 2-4. Standard Insecticide Aerosol, 2-Percent D-Phenothrin, NSN 6840-01-067-6674. Use for Knockdown of Flying Arthropods Within an Enclosure Such as an Erected Insect Bar

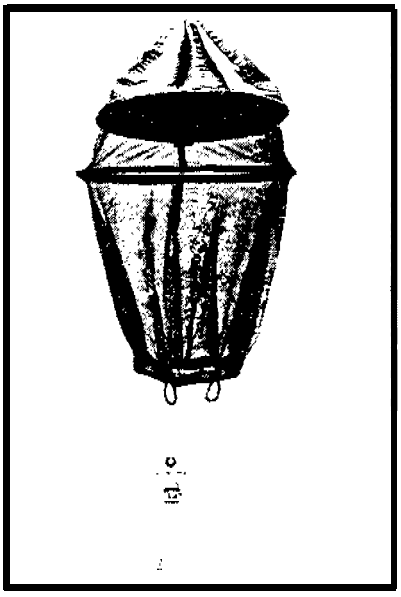


Figure 2-5. Insect Head Net, NSN 8415-00-935-3130

Figure 2-6. Insect Head Net Worn Over Helmet

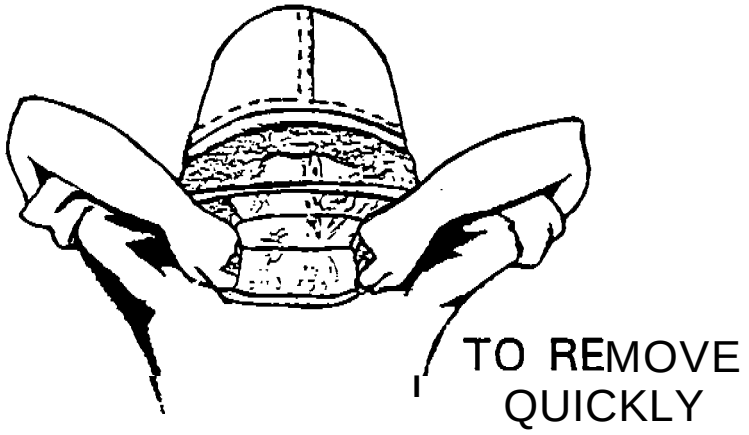


Figure 2-7. Remove Insect Head Net From the Back

(4) The head net is especially useful against mosquitoes or biting flies that tolerate repellents. It may be worn while sleeping.

(5) For added protection, the head net may be lightly sprayed with permethrin (see paragraph 2-7). Allow it to dry thoroughly before wearing. In the absence of permethrin, the net may be hand-impregnated with deet repellent (see paragraph 2-6) every evening by dispensing a small quantity onto the palm of one hand, rubbing the hands together to spread the repellent, and finally rubbing the netting between the hands. Repeat the process until all the netting has been evenly covered. It ,is not necessary to saturate the netting. KEEP DEET REPELLENT OFF OF THE ELASTIC AS IT NAY BE DAMAGED.

(6) Because of its small mesh size, the insect head net can be very hot for the wearer or may obscure vision, making it impractical in some climates and under certain deployed conditions.

-Section IV. Repellents

2-5. Introduct ion

a. The use of arthropod repellents on the skin (deet) or clothing (permethrin) is one of the most effective strategies for personal protection. The nomenclature and NSNs for these items are listed in Table 2-1.

b. Depending on the arthropod species, it may be necessary to apply repellents to the skin, the clothing, or both.

(1) Mosquitoes and some other biting flies bite exposed skin or through light-weight clothing, whereas black flies, sand flies, biting midges, ticks, chiggers, and fleas may crawl underneath clothing to bite, in addition to biting exposed skin.' Consequently, both types of treatments are necessary to provide maximum protection.

(2) Clothing applications of permethrin alone ordinarily do not adequately protect exposed skin because there is very limited vapor action. Rather, permethrin acts as a contact toxicant while deet is a vapor active repellent. However, one study demonstrates that after 9 hours, when all the subjects in a study group were wearing permethrin-treated uniforms, the toxic effect of permethrin reduced the numbers of mosquitoes and thus the biting rate by as much as 94 percent[42].

(3) When wearing heavy clothing, a repellent applied to the exposed skin alone may provide adequate protection from mosquitoes and some other biting flies. However, the best overall protection, especially when several kinds of arthropods are a problem, remains the combined use of both clothing treated with permethrin and skin treated with deet (see paragraph 2-8, DOD Repellent System).[9,14,41,42,49,51,53]

c. Proper use of repellents will also reduce problems posed by filth flies and other nuisance pests." No repellents appear to be significantly effective against stinging arthropods, such as bees, wasps, fire ants, and scorpions. The relative effectiveness of the repellents commonly used by the military is indicated in Table 2-2.

TABLE 2-2. EFFECTIVENESS OF REPELLENTS

Repellent	Mosquitoes	Other Biting Diptera	Ticks	Fleas	Chimers	Approved for use on clothing	Approved for use on skin
deet	xxx	XXX	XX	XX	xx	Yes	Yes
permethrin	XX	xx	XXX	xxx	xxx	Yes	No
Insect Repellent Stick*	X	X	X	X	X	Yes	Yes
DOD Repellent System (deet on skin: permethrin on clothing)	XXXX	XXXX	XXXX	XXXX	XXXX		

XXXX Best available
xxx Highly effective
xx Very effective
X Moderately effective

* Contains deet as the active ingredient.

2-6. DEET (N, N-Diethyl-3-methylbenzamide, formerly N,N-diethyl-m-toluaide)

a. Introduction. Since 1957, the military has used deet as the standard, all-purpose skin and clothing repellent." Deet is effective against a wide variety of species, including fleas, ticks, chigger mites, and especially mosquitoes and other biting flies.

b. Health and Safety Considerations.

(1) Deet has been used for over 30 years by millions of people worldwide. Although it has an excellent safety record, there have been sporadic reports of adverse reactions associated with its use. Most of these have been related to accidental exposure, such as swallowing or spraying into the eye. While most of the complaints involve transient minor skin or eye irritation, rare cases of toxic encephalopathy (neurological intoxication) have been reported, especially in young children, after ingestion or repeated topical application. These possible adverse reactions have included headache, nausea, behavioral changes, disorientation, muscle incoordination, irritability, confusion, difficulty sleeping, and in severe cases, convulsions, loss of consciousness, and death. While 50 to 100 million people use deet each year, there have been very few reports of neurological intoxication as a result of dermal application.

(2) Since there may always be a very small population of individuals who are sensitive to any chemical substance, it is important for personnel to apply repellents carefully and to be aware of possible signs of intoxication. Apply deet lightly and evenly to exposed skin and clothing. Avoid contact with sensitive mucous membranes (for example, eyes) and the lips (accidental ingestion). If the tactical situation permits, wash off the repellent after the potential exposure to arthropods has ceased.

c. Formulations. Three formulations, as well as a mesh parka which provides protection when deet-treated, are available through the military supply system.

(1) *Two-ounce bottle (Insect Repellent, Clothing, 75-percent deet, 25-percent ethanol, NSN 6840-00-753-4963).*

(a) Until recently, the only formulation of deet available in the military supply system had been 75-percent deet in ethanol (Figure 2-8). This product is packaged in a P-ounce squeeze bottle. Now that a newer, improved deet repellent is available [paragraph 2-6c(3)], this product is no longer recommended for skin use. It is primarily intended for treating the insect repellent parka [paragraph 2-6c(2)].

Figure 2-8. Two-Ounce Bottle (Insect Repellent, Clothing, 75-Percent Deet, 25-Percent Ethanol, NSN 6840-00-753-4963)

(b) When permethrin (the clothing repellent of choice, see paragraph 2-7) is not available for impregnating clothing, the 75-percent deet formulation can be used as a clothing treatment. Apply to clothing by dispensing into the hands, rubbing lightly together, and spreading over the socks and all openings of the clothing such as the fly, neck band, and bottom of the trousers. Apply additional material to all areas of the uniform that fit snugly such as across the shoulders, elbows, hips, buttocks, and knees. Continue to apply until the whole bottle has been used. This treatment should last up to several days if the deet is not washed out by laundering, rain, perspiration, or fording streams.

(c) The 75-percent deet formulation is a strong plasticizer and must, therefore, be used with care since it will damage plastic, rubber, vinyl or elastic items such as watch crystals, combs, eyeglass frames and cases, and contact lenses. Deet does not damage nylon, cotton, or wool fabrics, nor does it affect the infrared signature of the soldier." It leaches rapidly out of clothing on contact with water.

(d) Storage and Disposal.

(1) Deet is both heat and cold stable. However, the diluent, ethanol, has a very low vapor pressure and is very flammable. Therefore, exposure of the product to flame or excessive heat should be avoided. Because of the volatility of ethanol, it will evaporate over time, creating a more concentrated product. Under optimum conditions, the shelf-life of this product is indefinite.

(2) This formulation should never be stored in close proximity to calcium hypochlorite because the two products will react violently if they contact one another. Flash fires have been known to occur in such cases.

(3) Dispose of empty containers by wrapping in newspaper or a plastic bag and discarding in the trash. Under contingency conditions, bury the empty containers.

(2) Insect repe 1 lent parka.

(a) An insect repellent parka or overjacket is available (small, medium, large: NSN 8415-01-035-0846; -0847; -0848, respectively) (Figure 2-9). The parka is made from wide-mesh polyester-cotton netting, and is worn over outer clothing after being treated with a full 2-ounce bottle of 75-percent deet (NSN 6840-00-753-4963). One bottle of deet is supplied with the parka, but subsequent bottles for re-treatment must be requisitioned separately.- The parka is-waist-length, has extra long sleeves and a hood. It is packaged in a ziplock plastic bag in which it is treated and stored when not in use to retain repellent effectiveness. If the deet is not washed out, the parka will remain effective against mosquitoes, biting midges, and other biting flies for about 6 weeks before re-treatment is necessary. The parka offers no protection unless it is treated with repellent.

(c) Results of a study performed by the U.S. Army Medical Materiel Development Activity, Fort Detrick, Maryland, indicates that this repellent does not adversely affect the seal of the individual protective mask, M17.[25] However, the mask should be washed after each use with deet to preclude damage to its surfaces.

(d) Storage and disposal..

(1) This product is water-based and nonflammable. It is heat and cold stable, but at 140 °F, some separation is possible and the product may begin to leak from the container.[33]

(2) After dispensing the contents, wrap the container in newspaper or a plastic bag and discard in the trash. Under contingency conditions bury the empty container.

d. Insect repellent stick. personal application.

(1) This product is a l-ounce, waxy repellent stick marketed as Cutter® Insect Repellent Stick (NSN 6840-00-142-8965) (Figure 2-11). It contains 33-percent deet in a waxy base. It repels mosquitoes, biting midges, stable flies, sand flies, black flies, ticks, fleas, and chiggers. Its stable waxy formulation and convenient small size make it suitable for inclusion in the Air Force survival kit. This formulation, however, is not as effective as the extended-duration deet lotion or the permethrin clothing impregnant.

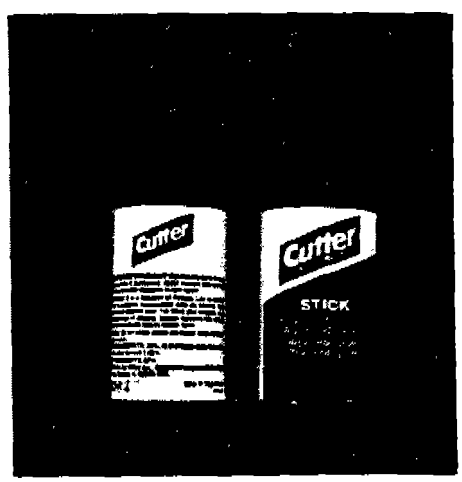


Figure 2-11. **Insect Repellent Stick, Personal Application, l-Ounce, 33-Percent Deet , NSN 6840-00-142-8965**

® Cutter is a registered trademark of Miles, Inc., 7123 West 65th St, Chicago, IL 60638-4698.

Figure 2-9. Insect Repellent Parka, NSN 8415-01-035-0846; 0847; 0848 (Small, Hedium, Large, Respectively)

(b) After removing the bottle of deet repellent and the instruction sheet from the bag, pour the repellent onto the top and sides of the folded parka in the bag. Reseal the ziplock bag for 24 hours, remove the parka from the bag and air-dry for at least 1 hour before using. Save the bag for storage and re-treatment of the parka. When necessary, re-treat the parka in the same manner.

(c) For best results, wear the insect repellent parka over an undershirt or the uniform shirt to augment the physical protection afforded by clothing and to avoid possible skin irritation. The hood should be worn over the helmet or the bare head, and can be drawn up snugly when necessary to prevent bites to the head. Wear the sleeves over the hands whenever possible. At times, exposed skin areas and untreated clothing not covered by the parka may not receive adequate protection, and the supplemental use of skin or clothing repellent may be required.

(3) Two-ounce tube (Insect Repellent, Personal Application, 3M/EPA 58007-1, extended- dura t ion, NSN 6840- 01-284- 3982).

(a) In 1990, a new formulation of deet, containing 33-percent active ingredient in a controlled-release polymer base became available (Figure 2-10). THIS IS CURRENTLY THE MILITARY SKIN REPELLENT OF CHOICE. It is a nongreasy, white lotion with a mild, pleasant odor. Although retaining some plasticizing properties, it is much less damaging to commonly used plastics. The product forms a thin film over the skin, and the polymer slows the loss of deet from the skin surface through absorption, abrasion, evaporation, and dissolution by perspiration, thereby greatly extending its protection time. Laboratory testing has indicated that the formulation provides 6 hours of at least 95-percent protection against a variety of mosquito species in a tropical environment, 10 hours in a hot, dry environment, and 12 hours in a forested/wet environment".

(b) According to label directions, the lotion should be dispensed into the hand, then the hands rubbed lightly together before applying thoroughly in a thin layer over the forearms, upper arms, face, neck, ears, and other exposed areas. Be sure to apply the lotion to your skin 2 to 3 inches underneath the edges of the uniform, since arthropods such as sand flies and black flies will crawl into these areas to bite. However, do not apply deet to extensive areas covered by clothing, especially where clothing fits tightly against the skin. This will help avoid potential irritation caused by heat, sweat, and abrasion. DO NOT APPLY REPELLENT TO THE EYES AND LIPS, OR TO SENSITIVE OR DAMAGED SKIN (FOR EXAMPLE, SUNBURN AND POISON IVY). To preclude possible damage, do not smear on plastic eyeglass frames, painted or varnished surfaces, some synthetic fabrics (nylon excepted), or other plastic and vinyl items.

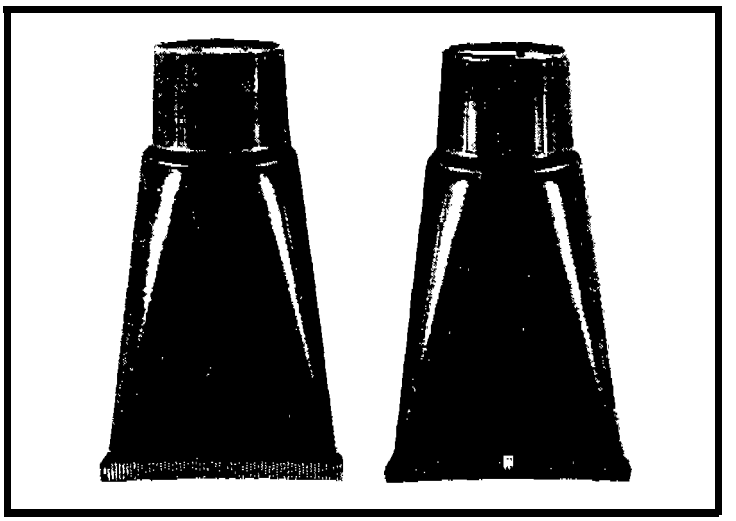


Figure 2-10. Standard Military Skin Repellent, 2-Ounce Tube, 33-Percent Deet, Extended-Duration, NSN 6840-01-284-3982

(2) To use, push the stick up ½ inch. Apply over all exposed skin. Avoid the eyes and lips. For chiggers, fleas and ticks, also apply to the socks, tops of the shoes, and around all openings in the outer clothing. The product will not damage nylon, cotton, or wool. However, it may damage some synthetic fabrics, plastics, paints, and varnishes.

(3) Storage and disposal.

(a) The Cutter Insect Repellent stick is cold stable. At 140 "F, however, the stick will begin to melt and leakage from the container can be expected.[30] The product is not flammable, and under optimum conditions, the shelf-life is indefinite.

(b) After using the contents, wrap the container and discard in the trash. Under contingency conditions, bury the empty container.

2-7. Permethrin [(3-phenoxyphenyl) methyl (+/-) cis/trans 3-(2,2-dichloroethenyl) 2,2-dimethyl-cyclopropanecarboxylate].

a. Introduct ion.

(1) Permethrin is the most recent addition to the arsenal of personal protective repellents, and it is the most effective clothing impregnant available. Its primary mode of action is contact toxicity, particularly against crawling arthropods such as ticks[18,26,45,47,48], chigger mites[5], fleas", and lice.[27,52] Permethrin also acts as a contact repellent against mosquitoes and biting flies. It is odorless, nonirritating, and resistant to washing and wear abrasion (rubbing off).[44,50] Uniforms impregnated with permethrin were shown to provide almost loo-percent protection against tick bite after 5 washings?, and unpublished data show that even after 50 cold water rinses permethrin-impregnated fabric caused loo-percent mortality in mosquitoes and ticks (Aedes aeavuti and Amblyomma americanurn, respectively)." In the case of human lice, permethrin-treated clothing offers a new passive approach to control which was not previously feasible.- Previous control agents were either less effective (M-1960[60], clothing impregnant) or were promoting resistance in louse populations (lindane[56], dust).

(2) Because of its low vapor pressure, permethrin does not provide protection to exposed skin adjacent to treated clothing. However, by treating uniforms and other articles such as tents, bed and head nets, and camouflage helmet covers, flying arthropod populations in a limited area may be reduced, since arthropods which first land on treated clothing will be killed.[42]

(3) Permethrin can be used to treat hot weather (loo-percent cotton) and temperate (50-percent/50-percent nylon/cotton; woodland or desert camouflage) military field uniforms. Treat uniforms before leaving

continental United States (CONUS), or as soon as possible once deployed. Nomex®/Kevlar flight suits may also be treated because tests show that fire -retardant properties are unaffected by this formulation.= Once treated, DO NOT DRYCLEAN UNIFORMS. This procedure completely removes the permethrin.[20]

(4) Other cloth items such as tentage, mosquito netting, camouflage helmet covers, and ground covers may also be treated in the field.

. . b. Health and Safetv Considerations.

(1) The uniform cap should not be treated with permethrin because of the potential for excessive permethrin absorption through the scalp. Treatment of the cap is not critical since, due to its construction, it is considered impenetrable to biting insects.

(2) Also, do not treat underwear. Permethrin is toxic to the nervous system of insects, but in mammals the chemical is poorly absorbed and then is rapidly inactivated by ester hydrolysis,'- However, since the scrotal area is far more likely to absorb topical substances than areas such as the thigh or the back", wearing untreated undergarments significantly reduces the risk of exposure to fabric impregnants.[24]

(3) Various precautionary measures should be observed when handling and mixing permethrin. Avoid permethrin contact with the face, eyes, and skin, and avoid breathing vapors or spray mist. Do not allow skin contact with treated surfaces until the chemical has dried completely. Wash hands thoroughly after handling wet, treated uniforms and before eating or smoking. In case of contact with the eyes, flush with plenty of water, and for contact with skin, wash with soap and water. 6et medical attention if irr-itation persists. Do not allow the chemical to contact food, mess gear, or water supplies. Thoroughly wash dishes and utensils contaminated with permethrin, This pesticide-is extremely toxic to fish. Keep out of lakes, ponds, or streams. Do not contaminate water by cleaning equipment, disposal of wastes, or with runoff resulting from treatment of uniforms.

C. Formulations. Several different formulations of permethrin are available within the military supply system.

(1) *Aerosol spray (Insect Repellent, Clothing Treatment, NSN 6840-01-278-1336).*

® Nomex is a registered trademark of E.I. DuPont de Nemours and Co., Inc., Wilmington, Delaware.

(a) This product contains 0.5-percent permethrin in a 6-ounce can. The commercial version is sold under the tradenames Permanone® Tick Repellent, Coulston's™ Permethrin™ Tick Repellent, Coulston's Duranon™ Tick Repellent, and Coulston's Permethrin Arthropod Repellent. Under section 24c of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA),[34] Permanone was commercially available, until recently, only in those states which had approved its use. In early 1991, the Environmental Protection Agency (EPA) granted a full registration to the Coulston International Corporation and Fairfield American Corporation for aerosol permethrin formulations. However, each state still retains the authority to accept or deny the sale of these products within state boundaries. In 1990, the EPA approved a DOD label for the stockage and use of 0.5-percent permethrin aerosol by the military (Figure 2-12), regardless of its commercial regulatory status. It can be used to treat military field uniforms (Figure 2-13), as well as mosquito netting (bed net, Figure 2-14, and head net, Figure 2-15). DO NOT TREAT THE UNDERWEAR OR CAP.

(b) All applications should be made outdoors. Select a location protected from the wind. Holding the can at a distance of 6 to 8 inches from the clothing (while not being worn), spray with a slow, sweeping motion.

(1) The military label instructs to spray the outer surfaces of the uniform, back and front,, until the surface of the fabric appears moistened and a slight color change is noted (the original color will be restored when the uniform dries). Treat the shirt and then the trousers, each for a minimum of 30 seconds on each side. Use approximately three fourths of the can to treat one complete field uniform. Pay particular attention to the trouser cuffs and the shirt cuffs.

(2) The outer surface of the socks may also be lightly sprayed, regardless of whether they are cotton, wool, or a synthetic. The most critical areas are the top and front portions of the socks. This will aid in protecting against chiggers and tiny immature ticks which may find their way through the boot eyelets. The top and eyelet areas of the boot itself may also be lightly sprayed. The remainder can be used to spray mosquito netting.

(3) Allow the uniform to dry completely before being worn. This takes approximately 2 hours (or up to 4 hours under humid conditions). If possible, and if time permits, allow to dry in a shaded area because sunlight hastens degradation of permethrin. Follow standard field uniform laundering procedures weekly. Reapply after 6 weeks or the sixth laundering, whichever comes first.

® Permanone is a registered trademark of Fairfield American Corp., 238 Wilson Ave., Newark, NJ 07105.
™ Coulston's, Permethrin, and Duranon are registered tradenames of Coulston International Corporation, P.O. Box 30, Easton, PA 18044-0030.

Armed Forces Pest Management Board
DEPARTMENT OF DEFENSE LABEL FOR PERMETHRIN ARTHROPOD REPELLENT
Approved by the Environmental Protection Agency 8 May 1'990

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

SHAKE WELL BEFORE USING.

To be used for treatment of hot weather and temperate military field clothing and mosquito netting only. Make all applications outdoors. DO NOT TREAT UNIFORM CAP.

For protection against mosquitoes and ticks select an outdoor area protected from the wind, spray outer surfaces of clothing (while not being worn) and mosquito netting with a slow sweeping motion to lightly moisten the surface of the fabric. Treat the clothing for a minimum of 30 seconds on each side and allow 2 hours (4 hours under humid conditions) to dry prior to being worn. Hold can at a distance of 6 to 8 inches from the object being treated. Treatment should moisten the surface of the fabric enough to cause a slight color change. Use approximately ¾ of this container to treat one complete field uniform. Use remainder on mosquito netting.

Treat the entire outside surface of clothing with special attention to sock, trouser cuffs, and shirt cuffs. Pant cuffs should be worn inside the socks or footwear to ensure full protection against ticks and chiggers. This item must be used in conjunction with the standard issue repellent approved for application to exposed skin areas to achieve maximum protection from mosquitoes. Follow standard field uniform laundering procedures weekly. Reapply after six weeks and sixth laundering.

DISPOSAL: *Replace cap, wrap container in several layers of newspaper. Discard in trash. Do not incinerate or puncture. In field situations bury the container.*

6840012781336

Precautionary Statements Hazards To Humans And Domestic Animals

CAUTION

Avoid contact with face, eyes, or skin. Avoid breathing vapors or spray mist. Wash thoroughly after handling and before **eating** or smoking. **Do** not allow contact with treated surfaces **until** spray has dried. Do not allow spray to contact food, or water supplies. Thoroughly wash dishes and food handling utensils contaminated with this product.

Statement of Practical Treatment

If On **Skin:** Wash affected areas of skin **with** soap and water.

If In Eyes: **Flush** eyes with plenty of **water.** Contact a physician if irritation persists.

If Inhaled: **Remove affected person** to well-ventilated area, if not already done. Apply artificial respiration if indicated.

Physical Hazards

Contents under pressure. Do **not use** or store near heat or **open** flame. Do not puncture or incinerate container. Exposure to temperatures above **130** Degrees F may cause bursting.

EPA REG. NO. 50404-5
EPA EST. NO.: **10900-OH-1**
COULSTON INTERNATIONAL CORPORATION
P.O. BOX 30
EASTON, PA 18044

NSN **6840-01-278-1336**
CAGE 0C4A6

PERMETHRIN ARTHROPOD REPELLENT

Insect Repellent, Clothing Treatment

1 Each
DLA400-89-D-1047
A04/90

DO NOT APPLY TO SKIN

Kills/Repels Mosquitoes and Ticks

For Use and Distribution within the Department of Defense **Only**

"Military **Field Clothing and** Mosquito **Netting** Only.

**ACTIVE INGREDIENT:

Permethrin	0.5%
INERT INGREDIENTS. .	**99.5%**
	100.0%

*Hot Weather (100% Cotton) and Temperate (Nylon/Cotton]; **50:50)** Field Uniforms Only.

****(3-phenoxyphenyl) methyl (+/−) cis/trans 3-(2, 2-dichloroethenyl) 2, 2-dimethyl cyclopropanecarboxylate *Cis/Trans* ratio: min. 35% (max. *40%)* (+/−)** Cis and max. 65% (min. 60%) (+/−) *trans.*

KEEP OUT OF REACH OF CHILDREN

CAUTION

See side panel for additional precautions.

Net Contents 6 oz.

Figure 2-12. Department of Defense Label for 0.5-Percent Permethrin Aerosol, Insect Repellent, Clothing, Treatment, NSN 6840-01-278-1336

Figure 2-13. Applying Permethrin Aerosol (NSN 6840-01-278-1336) to Field Uniform

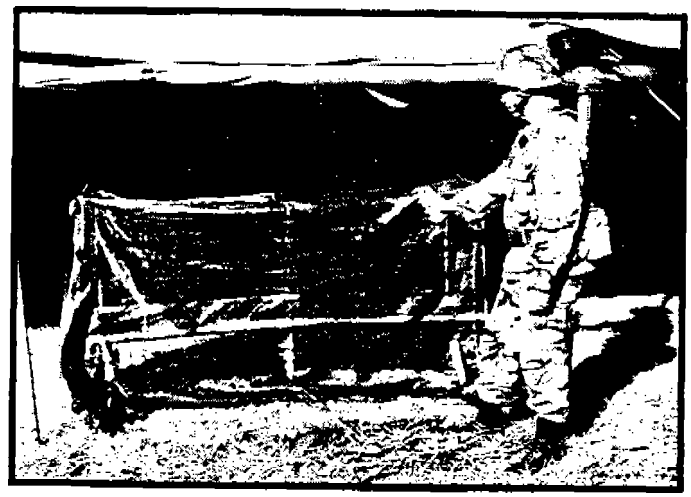


Figure 2-14. Applying Permethrin Aerosol (NSN 6840-01-278-1336) to Insect Bar (Mosquito Bed Net)

Figure 2-15. Applying Permethrin Aerosol (NSN 6840-01-278-1336) to Insect Head Net

(c) Storage and disposal.

(1) The product label recommends that the aerosol should not be exposed to temperatures above 130 °F because this could cause bursting. However, a safety factor is incorporated into this recommendation, since testing by the manufacturer indicates there is no apparent effect on the integrity of the can or its contents at temperatures up to 200 °F. At temperatures below 32 °F, permethrin will begin to crystallize out of solution, but upon return to temperatures of 60-80 °F, it redissolves with no effect on the quality of the product[32]. The shelf life of the aerosol is a maximum of 5 years, with a recommended storage time of 3 years to ensure no deterioration of the can and subsequent leakage of the contents.[31]

(2) After the contents of the can have been dispensed, replace the cap, wrap the container in several layers of newspaper and discard in the trash. As with any product under pressure, do not puncture or incinerate. Under contingency conditions, bury the empty container.

(2) 5.1-ounce (151 ml) bottle (Insect Repellent, Clothing Application, Permethrin, NSN 6840-01-334-2666).

(a) This product contains 40-percent permethrin emulsifiable concentrate (EC). It can be used on military field uniforms, netting, and tentage. Several steps are essential in mixing and applying this product. Wear protective gloves and a respirator when mixing and applying this formulation. Thoroughly clean a 2-gallon sprayer (see Table 2-1, NSN 3740-00-641-4719) by triple-rinsing with water. Add 1 gallon of clean water to the sprayer, followed by the contents of the 5.1 ounce bottle, and add a second gallon of water. This procedure helps to mix the water and permethrin. Agitate and bring to a pressure of 55 pounds per square inch (psi) (NSN 3740-00-641-4719 now comes equipped with a pressure gauge). When retrofitting older sprayers, use NSN 3740-01-332-8746, gauge, pressure, and NSN 4330-01-332-1639, filter, gauge (see Table 2-1). The maximum working pressure of the 2-gallon sprayer is 55 psi, and 40-55 full hand strokes are generally required to reach this working pressure, The required pressure can also be estimated by pumping the sprayer to maximum firmness (pumping will become very difficult). As soon as spraying begins, the pressure will progressively drop, requiring frequent repressuritations,

(b) To treat clothing (Figure 2-16), place the uniforms on the ground and spray each uniform at a distance of 12-18 inches using a fan nozzle at 55 psi. Spray evenly until very wet. This will require spraying the shirt and trousers separately, each for approximately 50 seconds on each side. Hang the uniforms for 3 hours or until dry. The garments may be safely handled and worn when dry.

Figure 2-16. Applying Permethrin, NSN 6840-01-334-2666, by P-Gallon Sprayer, to Multiple Field Uniforms

(c) DO NOT RE-TREAT THE UNIFORMS UNLESS AUTHORIZED BY MEDICAL AUTHDRITIES: one treatment is effective in preventing mosquito bites through the fabric for the life of the uniform. DO NOT TREAT THE UNDERWEAR OR THE CAP. Medical personnel should monitor the ongoing level of protection provided by the treated uniform. Re-treatment may be authorized after 10 launderings if bites by ticks, biting flies, or other arthropods begin to be experienced.

(d) To treat netting (Figure 2-17), spread the netting on the ground and spray at a distance of 12-18 inches using a fan nozzle at 55 psi. Spray with a slow sweeping motion to completely cover the netting fabric without runoff. For the bed net, fold neatly in half, spraying one side, then the other. Allow to dry before using. Re-treat after 1 year or six launderings.=

(e) To treat tentage (Figure 2-18), erect the tent and treat only the entryways and the inside surface (ceiling, walls and floor). Spray at a distance of 12-18 inches using a fan nozzle at 55 psi. Direct the spray to the walls, ceilings, and floor (if present) with a slow sweeping motion just to the point of runoff. Tests have shown that permethrin is compatible with the fire retardants, mildew inhibitors, and water and wind repellents used on general purpose, temper, and Arctic tents, as well as cotton tent liners." Re-treat after 9 months in temperate climates and after 6 months in tropical climates.[28]

Figure 2-17. Applying **Permethrin,** NSN 6840-01-334-2666, by Z-Gallon Sprayer, to Insect Bar (Mosquito Bed Net)

Figure 2-18, Applying **Permethrin,** NSN 6840-01-334-2666, by 2-Gallon Sprayer, to Internal Surface of Tent

(f) Storage and disposal.

(1) Do not store products containing permethrin EC below 32 °F, because the permethrin will crystallize. However, the integrity of the product is restored when it is thawed, brought back to ambient temperature, and agitated until all the crystals redissolve. The flash point of 40-percent permethrin EC is 115 °F due to the flammable solvent used in the formulation. Although the product shows little or no decomposition at 122 °F after 30 days, storing the product in an enclosed space at or above 115 °F will increase the chance of explosion due to ignition of vapors.[32]

(2) When empty, the pesticide container should be recapped, wrapped in newspaper or placed in a plastic bag, and discarded in the trash. Under contingency conditions, bury the empty container.

(3) Pad roll, factory impregnation of camouflage cloth. In this method, camouflage cloth is industrially treated prior to fabrication into field uniforms. At the factory, the fabric is passed through a predetermined permethrin/ water emulsion bath in a Proctor Schwartz padder (or equivalent) and then through a set of squeeze rollers at a constant pressure resulting in a target treatment level approximating 0.125 mg/cm^2 (Figure 2-19).

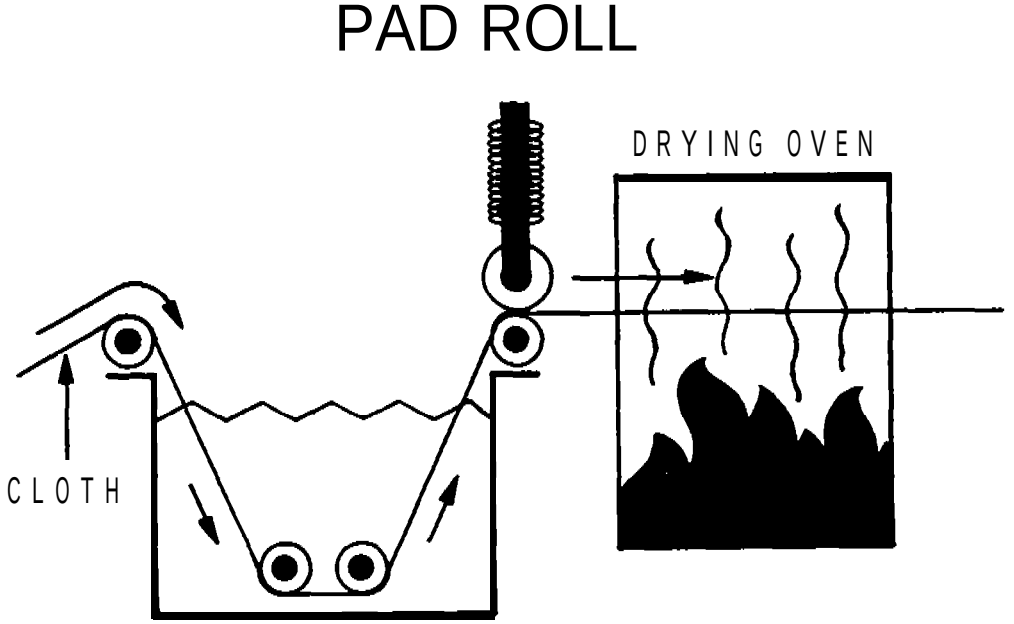


Figure 2-19. Pad Roll Industrial Process for Impregnating Camouflage Cloth with Permethrin

(4) Individual dynamic absorption application (IDAA) kit (NSN 6840-01-345-0237).

(a) This item is a protective treatment kit for military field uniforms that is intended for use by the individual soldier. The kit contains materials sufficient to treat one complete uniform (shirt and trousers): two tubes of permethrin (40-percent EC, 0.30-ounce each), two plastic treatment bags, two pieces of twine, one pair of disposable protective gloves, and one black marking pen (one pen per four kits) (Figure 2-20).

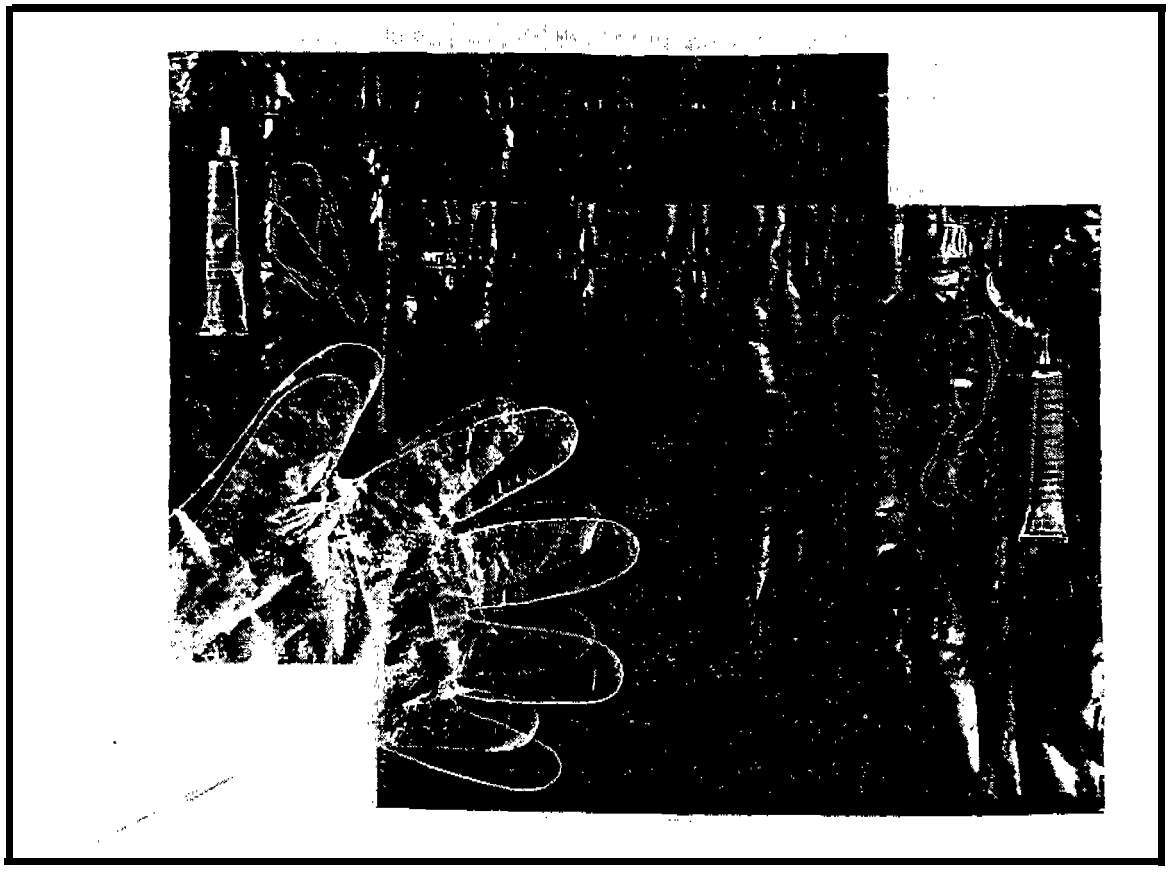


Figure 2-20. IDAA Kit, NSN 6840-01-345-0237, for Impregnating Single Field Uniform with Permethrin

(b) Wear the protective gloves when mixing to avoid accidental exposure to concentrated permethrin should spillage occur. Treat the uniform shirt and trousers separately, following the instructions printed on the back of each treatment bag (Figures 2-21 and 2-22).

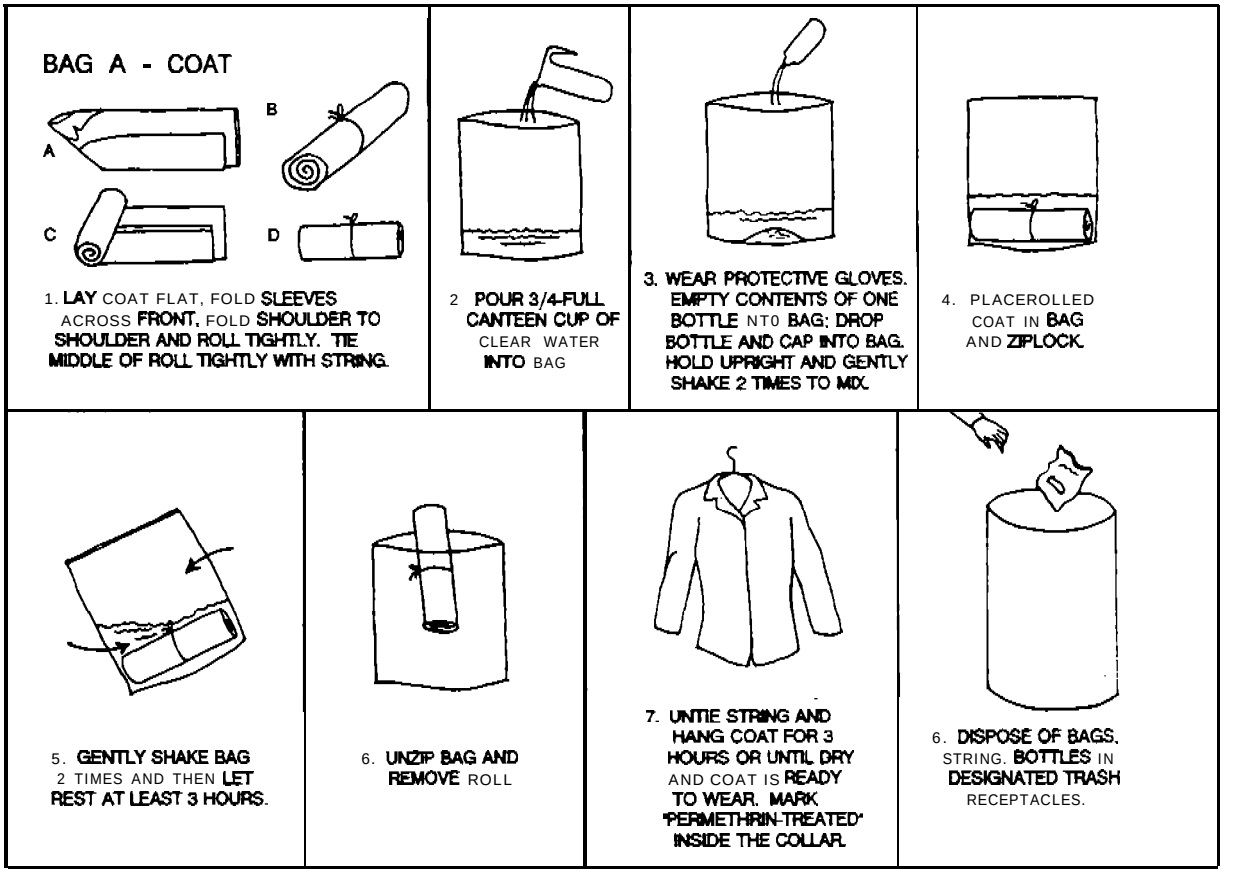


Figure 2-21. Instructions for Impregnating Coat-Half of Field Uniform with Permethrin, as They Appear on Bag A of the IDAA Kit

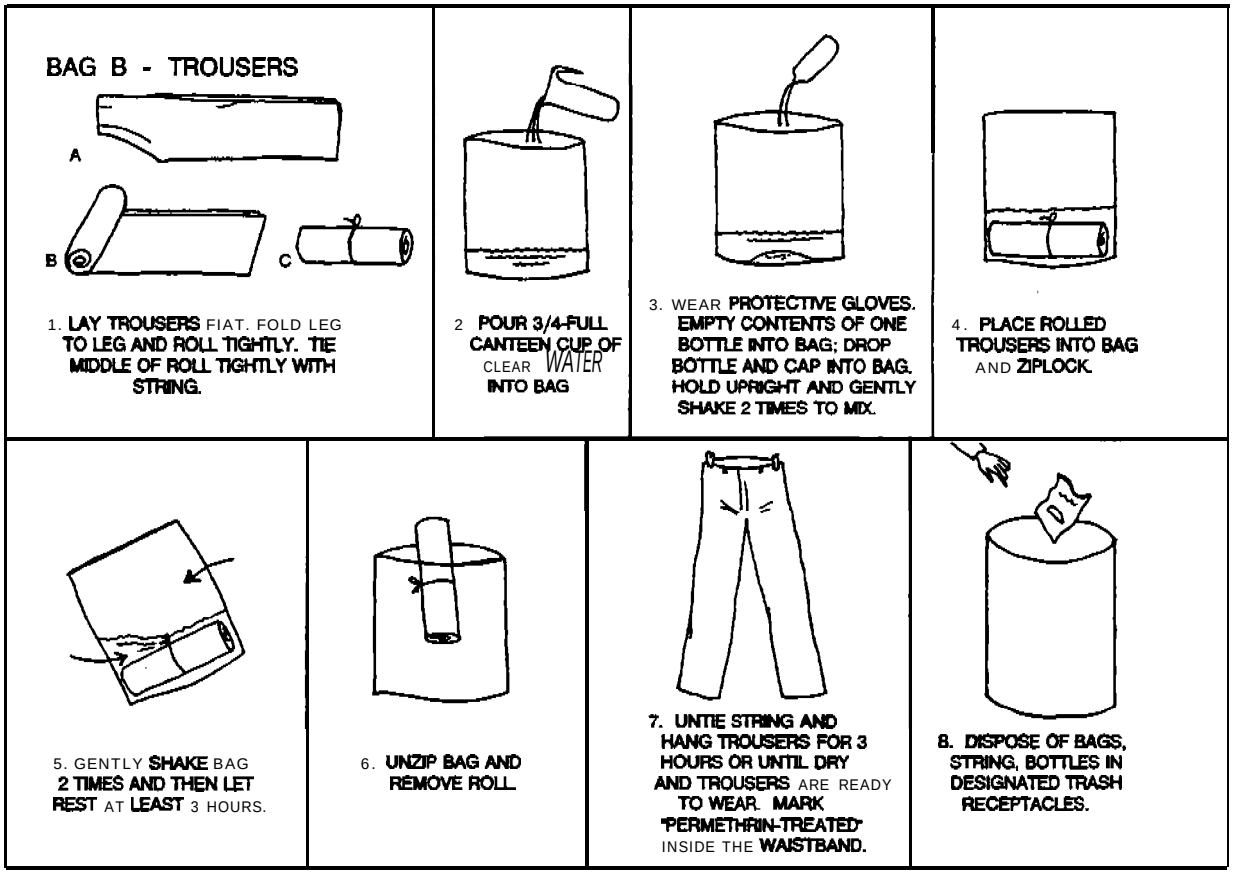


Figure 2-22. Instructions for Impregnating Trouser-Half of Field Uniform with Permethrin, as They Appear on Bag B of the IDAA Kit

(c) See Figure 2-23 for steps 1 through 9. Assemble all materials (Step 1'). Pour approximately 3/4 of a canteen cup (500 ml) of water into one of the bags (Step 2), add the contents.of one of the tubes of permethrin (Step 3), and gently agitate to mix (Step 4).

Step 1. Assemble Contents of the IDAA Kit

Step 2. Adding 3/4-Canteen Cup of Water to a Treatment Bag

Step 3. Add Contents of One Tube of 40-Percent Permethrin EC to a Treatment Bag

step 4. Agitate Treatment Bag to Mix Water and Pemethrin

(d) After rolling and tying the garment according to the instructions, place it in the bag (Step 5), ziplock, agitate again (Step 6), and allow to sit for 2-1/2 hours or more (Step 7). During this time, all the liquid is absorbed by the garment. Unzip the bag, remove the garment, and hang for 3 hours or until dry (Step 8). When completely dry, the garment is ready to wear. It has been impregnated with permethrin at the rate of 0.125 mg/cm^2. With the black pen, mark the inside coat collar and the inside waist band 'Perm treat, mo/yr.' The ink and marking will remain through at least 50 launderings (i.e., the life of the uniform).

Step 5. After Rolling and Tying the Garment, Place it in the Treatment Bag

Step 6. Agitate the Treatment Bag to Initially Wet. the Whole Rolled Garment

Step 7. Allow Garment to Sit in Treatment Bag for 2-1/2 Hours, or More, Until All the Liquid is Absorbed

Step a. Remove Garment from Treatment Bag and Hang for 3 Hours, or More, Until Completely Dry

(e) DO NOT RE-TREAT THE UNIFORM UNLESS AUTHORIZED BY MEDICAL AUTHORITIES: one treatment is effective in preventing mosquito bites through the fabric for the life of the uniform. DO NOT TREAT THE UNDERWEAR OR THE CAP. Medical personnel should monitor the ongoing level of protection provided by the treated uniform. Re-treatment may be authorized after 10 launderings if bites by ticks, biting flies, or other arthropods begin to be experienced.

(f) Starching field uniforms prior to treatment with permethrin does not adversely affect impregnation. In a study performed at the Natick Research, Development, and Engineering Center (NRDEC)[21], homogeneous absorption of permethrin by the fabric was achieved in both hot and temperate weather uniforms whether they were or were not starched prior to treatment. After 50 laundry cycles, both starched and unstarched hot weather uniforms showed similar permethrin retention levels, while temperate weather uniforms that were starched and pressed first, retained five times more permethrin than unstarched uniforms.

(g) In another NRDEC study[21], permethrin-impregnated and untreated temperate weather field uniforms were laundered together. No significant transfer of permethrin from treated to untreated uniforms during laundering was found.

(h) Store as described in paragraph 2-7c(2). Do not reuse empty treatment bags. Place all used kit components into one treatment bag, zip closed, and put in the trash, or bury in the field (Step 9).

Step 9. Place All Used IDAA Kit Components Into One Treatment Bag, Zip Closed, and Put in Trash

2-8. DOD Repellent System

THE BEST STRATEGY FOR DEFENSE AGAINST DISEASE-BEARING ARTHROPODS includes the application of extended-duration deet lotion to exposed skin, coupled with the application of permethrin to the field uniform. When used with a properly worn uniform, this system will provide nearly complete protection from arthropod-borne diseases (Figure Z-24).

Figure 2-24. DOD Repellent System

Section V.
Mechanical Modifications

2-9. Clear Leaf Litter and Underbrush

Clear away leaf Jitter and underbrush which provide habitat for arthropods, and forage and harborage for animal hosts. Raking is simple and efficient. For large areas, controlled burning of the understory may be necessary. This latter method requires considerable expertise and careful planning. It should only be attempted by trained personnel when other methods fail or are impractical, and after authorization has been obtained through appropriate environmental and medical channels.

Z-10. Eliminate Accumulated Water

Mosquito breeding sites should be eliminated or reduced by draining standing water, and by preventing water accumulation in containers, depressions in the ground, or other receptacles.

Sect ion VI.
Sanitation

2-11. Importance

Although not primarily a personal protective measure, it is the responsibility of each individual to participate in the overall unit sanitation effort. Once a bivouac site is established, sanitation is important. Garbage and other odiferous decaying matter will attract arthropods and other animal pests and should not be allowed to accumulate. These types of materials should be maintained in tightly closed containers, or should be buried, burned, or removed.

Section VII.
Pesticides

2-12. Applications

Pesticide treatment may be necessary when troops are to remain for a prolonged period of time in an area that is heavily infested with arthropods. Pesticide applications must only be performed by trained or certified individuals, and only after PVNTMED personnel determine that other protective and preventive measures are, or will not be, fully successful. Aerial applications can be

used for large areas, and should be conducted prior to deployment into the site. They must be conducted according to all applicable environmental laws and regulations.

Section VIII.
Hazardous Practices

2-h. Introduction

A number of commercial products which are not marketed for personal protection, are nevertheless being widely used by troops, as well as the public sector, for this purpose. These products include a concentrated bath oil, Avon Skin-So-Soft@, and flea and tick collars. Such products are less effective than the military repellents, and they may be hazardous when used in a manner not approved by the label. Medical personnel should instruct troops on the correct use of appropriate personal protective measures and should strictly prohibit the use of unauthorized products.

2-14. Commercial Products

a. Avon Skin-So-Soft.

(1) Schreck and Kline[39] field-tested this bath oil for repellency against several species of Culicoides biting midges. They reported that although the bath oil did not repel these insects, it did trap them in the oily film formed by the material on the skin, thereby preventing them from biting. However, the oiliness of this product and the large numbers of midges stuck to the skin after long-term exposure to high populations are drawbacks to its use.

(2) In another laboratory study by Rutledge et al", Avon Skin-So-Soft was tested for repellency to the yellow fever mosquito, Aedes aegypti. Although it was found to repel these mosquitoes for a short time, it was neither as effective nor as persistent on the skin as deet.

(3) It must also be emphasized that the label for Avon Skin-So-Soft directs to dilute 1/2-capful in a bathtub full of water. The safety of long-term applications of concentrated bath oil to the skin is unknown, and its use in such a manner is therefore strongly discouraged. The use of this product is unwarranted, since safe and more effective deet repellents are available in the military supply system.

® Skin-So-Soft is a registered trademark of Avon Products, Inc., 9 West 57th Street, New York, NY 10019-2014.

b. Flea and Tick Collars. Troops frequently use animal flea and tick collars around their wrists, ankles, arms, or beltlines. These collars contain many different kinds of pesticides which may have adverse dermal and/or systemic effects. Their safety has never been tested for human use. Most often, severe skin reactions are reported (Figure 2-25).

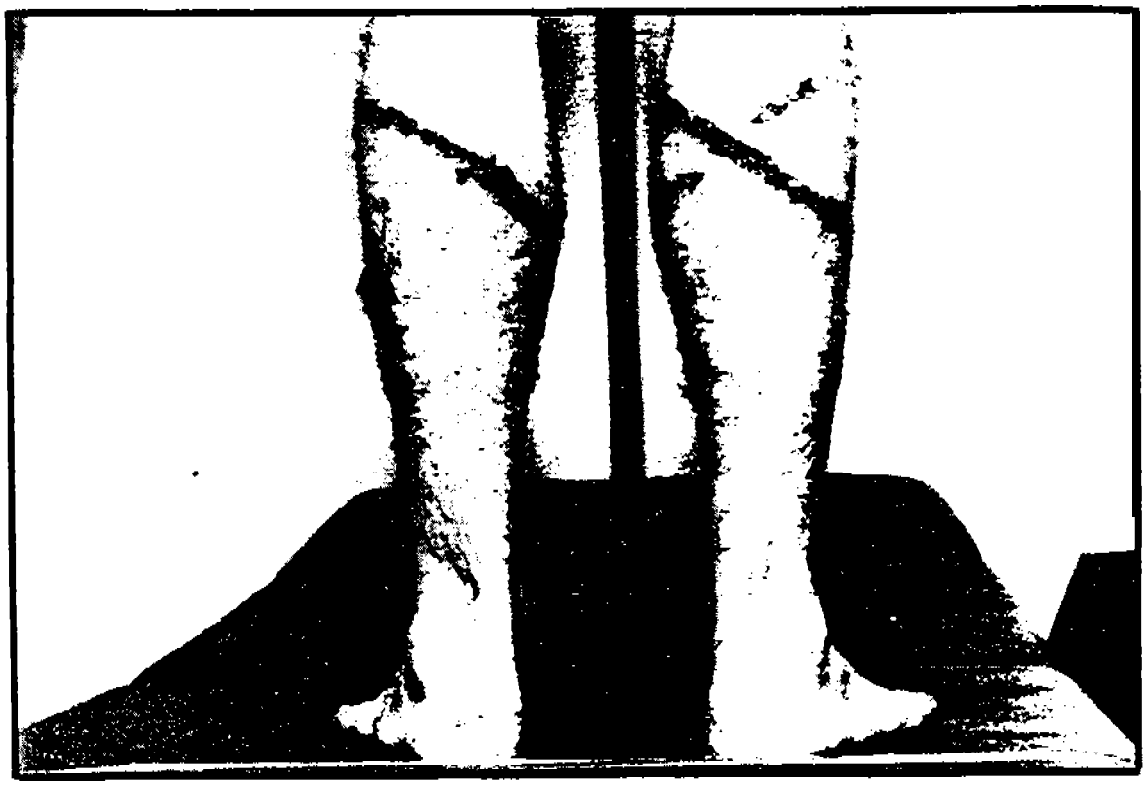


Figure 2-25. Skin Lesions Caused by Human Use of Flea and Tick Collars on the Legs

Section IX. Conclusion

2-15. Summary

Conscientious use of the DOD Repellent System (see Figure 2-24), and the other techniques described in this TG, will provide maximum, safe protection from arthropod attack.

2-16. Training Package

Since a great deal of technical details are also presented and interspersed throughout this document, a summary of the pertinent points will be useful as a training tool. See Appendix B for a proposed training package which can be presented by way of viewgraphs, slides, charts, or other appropriate manner.

APPENDIX A

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APPENDIX B

TRAINING PACKAGE

PERSONAL PROTECTIVE TECHNIQUES

AGAINST ARTHROPODS

VIEWGRAPH 1

IMPORTANCE OF PROTECTION

- Historically, more combat power has been lost due to disease and nonbattle injuries (DNBI) than from direct combat casualties
- Many of these diseases are transmitted by arthropods

ARTHROPODS INFLICT MANY STRESSES WHICH THREATEN THE MILITARY MISSION

- Physical - disease, painful bites, infections, dermatitis, allergic reactions
- Psychological - fear of arthropods, their bites, or disease
- Economic - Extensive medical care costs and loss of manpower

VIEWGRAPH 3

MAJOR ARTHROPOD PESTS/ DISEASES OF MILITARY IMPORTANCE

- Biting midges - Visceral filariasis, Oropouche fever
- Black flies - Onchocerciasis
- Deer flies - Eye worm disease
- Fleas - Plague, murine typhus
- Kissing bugs - Chagas' disease

VIEWGRAPH 4A

- Lice - Epidemic typhus, relapsing fever
- Mites - Scrub typhus, scabies, rickettsialpox
- Mosquitoes - Malaria, dengue, viral encephalitis
- Sand flies - Sand fly fever, leishmaniasis
- Ticks - RMSF, Lyme disease, babesiosis
- Tsetses - African sleeping sickness

VIEWGRAPH 4B

MECHANICAL DISEASE TRANSMISSION BY FILTH FLIES

- Dysentery
- Cholera
- Salmonella
- Shigellosis
- Typhoid fever

VIEWGRAPH 5

METHODS OF PROTECTION

- Avoidance
- Physical barriers
- Repellents
- Mechanical modifications
- Sanitation
- Pesticides

VIEWGRAPH 6

AVOID THE KNOWN HABITAT OF ARTHROPODS

- Use pest surveillance information from medical and intelligence personnel
- Choose bivouac sites that are dry open and uncluttered
- Avoid rodent burrows, local settlements animal pens
- Limit contact with indigenous human populations

VIEWGRAPH 7

AVOID SNAKES, SPIDERS, SCORPIONS

- Wear socks inside shoes or boots
- DO NOT walk around in bare or stocking feet
- Shake out boots before putting on
- Check concealed spaces before reaching into them

PHYSICAL BARRIERS

- Clothing
- Protective Equipment

VIEWGRAPH 9

CLOTHING

- Proper wearing of the field uniform
  - . Tuck pant leg into boot or sock
  - . Roll sleeves down
  - . Close collar
  - . Wear undergarments
  - . Wear field cap

VIEWGRAPH 10A

- Check clothing frequently for crawling arthropods (e.g., ticks)
- Buddy checks
- After undressing, check clothing and body
- Shower

VIEWGRAPH 10B

TICK REMOVAL

- Using tweezers, grasp mouthparts against the skin
- Pull back slowly, steadily and firmly
- Be patient!
- DO NOT crush or squeeze body of tick
- Wash wound site
- Apply antiseptic

VIEWGRAPH 11

PROTECTIVE EQUIPMENT

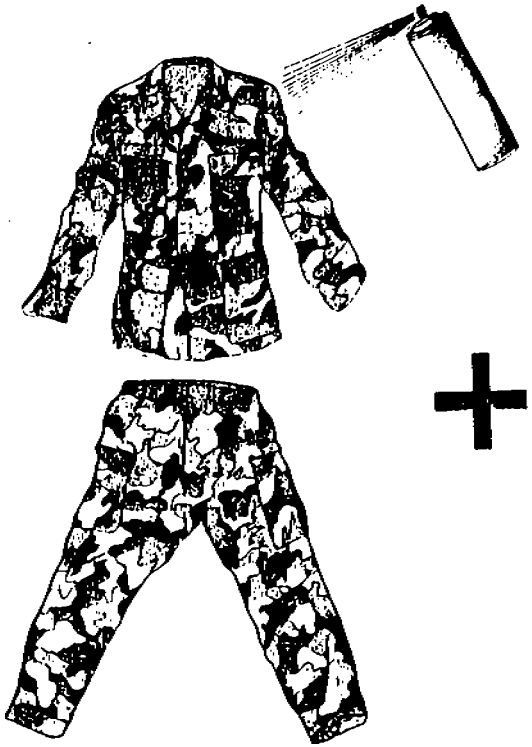
- Head net - Treat netting with repellents
- Bed net - Treat with repellents and use d-phenothrin inside erected bed net enclosure
- Tent screens - Keep light to a minimum at night

VIEWGRAPH 12

REPELLENTS

- Skin (deet) - vapor-active repellent
- Clothing (permethrin) - contact repellent; toxic to arthropods upon contact

DOD REPELLENT SYSTEM



permethrin on uniform

+

deet on skin

+

properly worn uniform

=

Maximum Protection

VIEWGRAPH 14

DEET FORMULATIONS

- Extended-duration deet lotion, 2-oz. tube - 33 percent - RECOMMENDED
- Deet liquid, 2-oz. bottle - 75 percent
- Insect repellent jacket (for use with deet liquid)
- Insect repellent stick (used in Air Force survival kit)

APPLICATION OF DEET
(Lotion or liquid)

- Spread thin film over all exposed skin
- Apply 2 inches under edges of uniform

VIEWGRAPH 16

PRECAUTIONS WHEN USING DEET

- DO NOT apply to eyes and lips
- DO NOT apply to sensitive or damaged skin
- DO NOT contact plastic, rubber, vinyl, or elastic
- DO NOT store near calcium hypochlorite
- Keep away from flame or excessive heat

VIEWGRAPH 17

PERMETHRIN FORMULATIONS

- Aerosol spray, 6 oz. can - 0.5 percent
- 5.1 ounce bottle - 40 percent emulsifiable concentrate (EC)
- Individual Dynamic Absorption Application (IDAA) kit - 40 percent EC
- Pad roll - factory impregnation

VIEWGRAPH 18

PRECAUTIONS WHEN USING PERMETHRIN

- Use ONLY on clothing
- DO NOT contaminate water - EXTREMELY TOXIC to fish, but low mammalian toxicity
- DO NOT treat underwear or cap
- Avoid breathing vapors

VIEWGRAPH 19

PERMETHRIN TREATMENT

- Field uniforms
- Bed netting
- Head nets
- Tents and tent screens
- Ground covers
- Camouflage helmet covers

VIEWGRAPH 20

AEROSOLSPRAY
0.5 PERCENT PERMETHRIN

- Use 3/4 can on one complete field uniform (trousers and shirt)
- Re-treat after 6 weeks or six launderings
- Use remainder on netting, etc.
- Shelf-life up to 3 years

VIEWGRAPH 21

5.1 OUNCE BOTTLE 40 PERCENT PERMETHRIN EC

- Use 2-gallon sprayer with pressure gauge
- Dilute in 2-gallons water
- Mix well
- Pressurize to 55 psi
- Treat multiple field uniforms, bed nets, tents
- Use fan nozzle and spray item at a distance of 12-18 inches

VIEWGRAPH 22

TREATMENT REGIMENS FOR 2-GALLON SPRAYER METHOD

- Clothing - Spray outside surfaces of front and back of the shirt and trousers until soaking wet (approximately 50 seconds per side per piece: total 200 seconds per uniform). DO NOT RE-TREAT UNIFORM: ONE TREATMENT EFFECTIVE FOR LIFE OF UNIFORM

VIEWGRAPH 23A

- Netting - Fold bed net in half, spraying one side, then the other, to cover completely without runoff. RE-TREAT AFTER 1 YEAR OR SIX LAUNDERINGS

- Tentage - Treat entryways and the inside surface (walls, ceiling, floor) until the point of runoff. RE-TREAT AFTER 9 MONTHS IN TEMPERATE, OR 6 MONTHS IN TROPICAL CLIMATES

VIEWGRAPH 238

PAD ROLL METHOD

- Industrial treatment of camouflage cloth prior to construction into uniforms
- Not performed by the individual

IDAA K I T

- Each kit contains: Two 3-ounce tubes permethrin (40 percent EC), two treatment bags, two pieces of twine, one pair disposable protective gloves, one marking pen
- Treat shirt and trousers ‘separately
- Wear the protective gloves when mixing, and when handling wet, treated uniform

VIEWGRAPH 25A

- Pour 3/4 canteen cup water in treatment bag
- Add contents of one tube permethrin
- Agitate to mix
- Roll and tie garment and insert into bag

VIEWGRAPH 25B

- Allow to sit for 2-1/2 hours to absorb permethrin solution
- Remove garment and hang until dry (approximately 3 hours)
- Mark inside waistband and collar ‘Perm ‘treat, mo/yr’
- Place used kit items into one bag. Dispose in trash or bury

VIEWGRAPH 25C

MECHANICAL MODIFICATIONS

- Clear away leaf litter and underbrush
  - Raking
  - Mowing
  - Controlled burning
- Drain standing water
- Prevent water accumulation in containers or depressions in the ground

VIEWGRAPH 26

SANITATION

- Each individual must participate in overall unit sanitation effort

- Maintain garbage and other odiferous decaying matter in tightly closed containers, or bury, burn or remove it

PESTICIDE TREATMENT OF THE ENVIRONMENT

- Should only be attempted when other protective and preventive measures are, or will not be, fully successful

- Should only be performed by trained or certified individuals

VIEWGRAPH 28

HAZARDOUS PRACTICES

- The use of products not approved and marketed for personal protection
- Less effective than approved products
- May be hazardous when used in a manner not authorized by the label

VIEWGRAPH 29A

DO NOT USE THE FOLLOWING PRODUCTS FOR PERSONAL PROTECTION:

- Avon Skin-So-Soft - Safety of extensive use of concentrated product on skin has not been evaluated; less effective than military repellents

- Animal flea and tick collars - Contain many different kinds of pesticides which can have adverse dermal and/or systemic effects

VIEWGRAPH 29B

GLOSSARY

AFMIC
Armed Forces Medical Intelligence Center

AFPMB
Armed Forces Pest Management Board

cm
centimeter

CONUS
continental United States

DNBI
disease and nonbattle injuries

DOD
Department of Defense

DPMIAC
Defense Pest Management Information Analysis Center

DVEPs
disease vector ecology profiles

EC
emulsifiable concentrate

EPA
Environmental Protection Agency

FIFRA
Federal Insecticide, Fungicide, and Rodenticide Act of 1972

IDAA
individual dynamic absorption application

mg
milligram

ml
milliliter

NRCED
Natick Research, Development and Engineering Center

NSN
national stock number

PCE
protective clothing and equipment

psi
pounds per square inch

PVNTMED
preventive medicine

TG
technical guide

VECTRAPs
vector risk assessment profiles

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